

**DEPARTMENT OF PLANNING & BUILDING****BUILDING DIVISION**

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CONSTRUCTION ON EXPANSIVE SOIL

FORM 4591

I. Purpose

The purpose of this handout is to summarize the department's policies and procedures relating to construction on expansive soil. When expansive soil is present at a building site, a special foundation design may be required. Parameters for this design are to be determined by a foundation investigation as described in Section 1802 of the California Building Code (CBC).

II. Responsibility

When a new building is to be constructed, it is the responsibility of the site owner and the professional consultants involved in the design and construction to determine if expansive soil is present on the site. If it is unclear whether or not expansive soil is present, or the extent to which the potentially expansive soil might affect the new structure, then a registered civil or geotechnical engineer should be retained to determine if a special foundation design is necessary. Once the degree and quantity of expansive soil is determined, the proposed structure must be designed accordingly. In some cases it may be necessary to retain two engineers, one (geotechnical engineer) to determine the extent of the expansive soil and provide design parameters, and another (structural engineer) to design the proposed building for the expansive soil per the geotechnical engineer's recommendations.

Prior to plan submittal, owners, designers and contractors are strongly advised to take the opportunity to determine if there is an expansive soil problem.

III. Geotechnical Report

A geotechnical report, prepared by a civil engineer registered in the State of California, is required whenever expansive soil is present. A geotechnical report is also required for all projects involving grading, new foundations, major site improvements or significant alteration to existing structures with foundation work. As a minimum, the report should include site preparation, allowable soil bearing values, expansion index test results and recommendations for foundation and slab design.

Single-Family/Duplex Additions

One and two story additions to existing residential single-family/duplex structures may qualify for a waiver of a soils investigation report. See Form 4597 "Request To Waive Soils Investigation Report." If the building inspector suspects expansive soil on the site during the foundation inspection and a geotechnical report has not been submitted, the building inspector may require the owner or contractor to retain a qualified civil or geotechnical engineer

to provide a soil report with foundation recommendations before work can progress. The report could require re-submittal of plans to the Building Division to verify that the engineer's recommendations have been incorporated in the foundation design.

IV. Expansive Soil Tests

- A. When the expansive characteristics of a soil are to be determined, the procedures shall be in accordance with the following method:

1. See CBC Section 1802.3.2.

- B. When the expansion index is 20 or less and no special design recommendations are required, the following note should be placed on the foundation plan: "Expansion index has been determined to be 20 or less and no special design recommendations are required."

Civil or Geotechnical Engineer _____,

Registration No. _____,

Company Name _____,

Date _____."

- C. When the expansion index is greater than 20, the engineer must make recommendations and the designer must incorporate these recommendations in the building design. The following note should be placed on the foundation plan: "Expansion index has been determined and recommendations of the engineer have been incorporated into these plans."

Civil or Geotechnical Engineer _____,

Registration No. _____,

Company Name _____,

Date _____."

V. Building Design for Expansive Soil

When the expansion index is greater than 20, one of the following methods shall be used in the building design:

- A. The expansive soil problem may be mitigated by removal of the expansive soil and replacement with a non-expansive material. This solution may involve regarding the project site, or "mixing" expansive material with non-expansive in order to lower the expansion index.

Alternatively, the expansive soil surrounding and under the building may be removed to an appropriate depth, replaced with another material and compacted.

- B. Publication TF 700-R-03 from the Wire Reinforcement Institute. This is a design method for non-prestressed slab-on-ground foundations. Use of this standard shall be limited to buildings three stories or less in height in which gravity loads are transmitted to the foundation primarily by means of bearing walls constructed of masonry, wood or steel studs, and with or without masonry veneer.

- C. Post-tensioning Institute method for post-tensioned slabs-on-ground.

The same limitations specified in Item B of this section also apply.

- D. An alternate engineering design may be proposed. Section 108.7 of the CBC gives the building official the authority to consider alternate design procedures for expansive soil. The following procedures may be used for a slab-on-grade system where gravity loads are transmitted to the foundation by means of bearing walls constructed of masonry, wood or steel studs:

1. Where the expansion index (EI) is 90 or less, the foundation design may be specified by prescriptive foundation recommendations contained in the project soil report. In this case, the geotechnical report must contain specific recommendations for the foundation design. One possible example of these recommendations could be stated as follows:

“All footings must be a minimum of 18 inches into grade with two #5 reinforcing bars at the top and two #5 reinforcing bars at the bottom of each footing. All slabs are to be a minimum of 5 inches thick with supported #4 reinforcing bars 18 inches on center. The soil must be wetted to a specified moisture content and depth 24 hours prior to placement of concrete. The engineer must verify the correct soil moisture content prior to placement.”

The prescriptive recommendations in the geotechnical report will generally be the time tested foundation designs that have proven satisfactory after years of experience with the local climate and soil conditions. These recommendations are to be based upon the engineering judgment of the civil/geotechnical engineer for a particular site and structure.

The recommendations of the engineer must be incorporated into the building plans. The structure's foundation plan must contain the detailed requirements specified in the geotechnical report. In order to ensure that the foundation plan has been detailed according to the engineer's requirements, the foundation plan must be reviewed and signed by one or more registered professionals. Alternatively, the engineer may submit a letter stating that he/she has reviewed and approved the foundation plan for the project.

2. Where the expansion index (EI) is greater than 90, a more rigorous design procedure is required. This design is to be accomplished by registered professionals, preferably by a geotechnical engineer in conjunction with a structural engineer. The design must be based upon the expansion parameters of the soil system and the interaction of the soil and building foundation. The department has no prescribed

design method, but instead will expect the registered professionals involved to design the foundation using a rational design procedure based upon soil testing. Some factors, which may need to be considered, are listed below:

- a. Site drainage
- b. Soil expansion and contraction
- c. Applied pressure due to soil expansion
- d. Allowable slab cracking
- e. Soil moisture content at concrete placement
- f. Slab/footing design for imposed building loads
- g. Type of reinforcing
- h. Slab and footing stiffness
- i. Effect of utility trenches
- j. Need for vapor barriers